



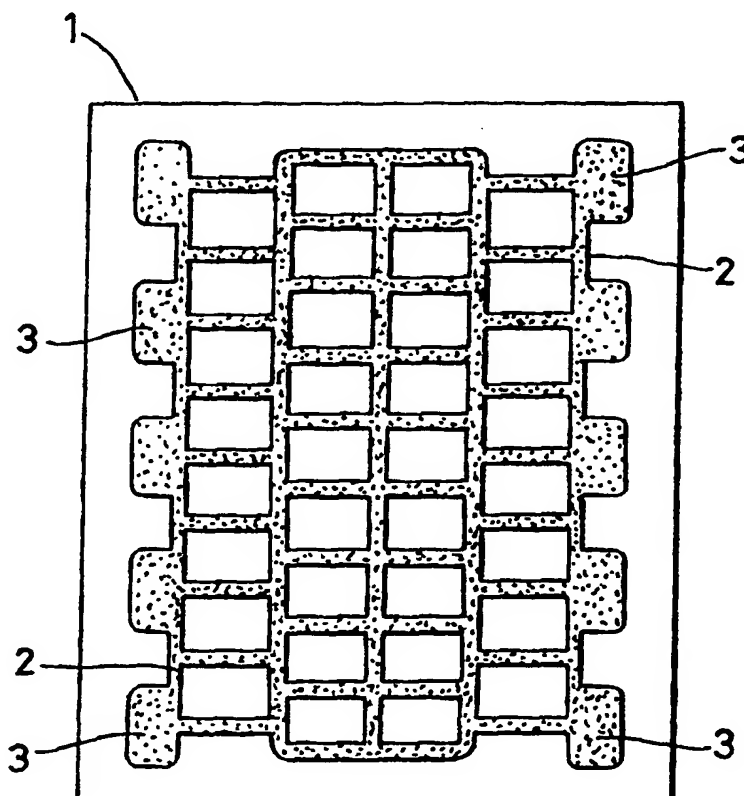
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>A61F 13/15, D06M 15/693, D04H 13/00</b>		<b>A1</b>	(11) International Publication Number: <b>WO 98/56326</b>
			(43) International Publication Date: 17 December 1998 (17.12.98)
(21) International Application Number: PCT/GB98/01703 (22) International Filing Date: 11 June 1998 (11.06.98) (30) Priority Data: 9712249.3 13 June 1997 (13.06.97) GB (71) Applicant (for all designated States except ES US): TEXON UK LIMITED [GB/GB]; 100 Ross Walk, Belgrave, Leicester LE4 5BX (GB). (71) Applicant (for ES only): TEXON MATERIALES, S.L. [ES/ES]; Ramón Turró, 109, 5ª Planta, E-08005 Barcelona (ES). (72) Inventors; and (75) Inventors/Applicants (for US only): CHAPMAN, Roger, Alan [GB/GB]; 3 The Wardens, Kenilworth, Warwickshire CV8 2UH (GB). JOHNSON, Susan, Gwynneth [GB/GB]; 3 Markfield Lane, Botcheston, Leicester LE9 9FH (GB). (74) Agent: GILDING, Martin; Eric Potter Clarkson, Park View House, 58 The Ropewalk, Nottingham NG1 5DD (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: MATERIAL SUITABLE FOR USE IN ABSORBING LIQUID AND METHOD OF MAKING SAME

## (57) Abstract

Sheet material for absorbing liquid has a first fibre layer with a pattern of a modifying agent applied thereto, the modifying agent being substantially more hydrophobic or hydrophilic than the fibres, thus modifying the performance of the fibre layer. A method of modifying the absorbency and liquid flow characteristics of a non-woven fabric comprising: (i) procuring a non-woven textile fibre first sheet material; (ii) selecting a modifying agent which is substantially more hydrophobic or hydrophilic than the fibres of the non-woven sheet material; and (iii) applying the modifying agent to the non-woven sheet material in a pre-selected pattern. The material made is of particular use as an absorbent layer in an incontinence product or wound dressing, facilitating the spread of liquid throughout the layer.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakistan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

**MATERIAL SUITABLE FOR USE IN ABSORBING LIQUID AND**  
**METHOD OF MAKING SAME**

- This invention is concerned with improvements in or relating to a material  
5 suitable for use in absorbing liquid and methods of making same and is  
especially concerned with making an absorbent material suitable for use in  
articles for absorbing bodily fluids, eg. incontinence products or wound  
dressings.
- 10 For many years wound dressings and incontinence products have been  
made comprising a simple absorbent material with surface layers arranged  
to allow transmission of wound exudate or incontinent fluid through to the  
absorbent material and to include a waterproof barrier militating against  
other items such as bed linen becoming wetted. Absorbent materials  
15 suitable for use in wound dressings may have a contact surface to allow  
transmission of exudate to the absorbent material and a backer layer to  
protect the absorbent material from contamination, etc. exterior to the  
wound site.
- 20 A typical known absorbent material is a wad of cotton wool or similar  
material. However, the absorbent capability of cotton wool is limited and  
more recently, more sophisticated non-woven felt or fabric constructions  
have been used as an absorbent material. These non-woven felts can be  
needle-entangled in order to create expanded structures for the absorbent  
25 material with the result that greater volumes of liquid can be collected and  
retained within the absorbent material. These non-woven felts may be  
formed from hydrophobic and/or hydrophilic fibres as required by desired  
performance.

Previously known non-woven felts do not address one further problem with absorbent materials with regard to spread of liquid away from the vicinity at which it is absorbed by the absorbent material. Failure to remove the liquid, whether it be incontinent or wound exude, from the region adjacent the source of the liquid means that that particular area remains constantly wet with the potential problems of bed sores and failure to utilise the full absorption potential of the absorbent material.

One of the various objects of the present invention is to provide an improved absorbent material suitable for use in absorbing liquid.

In one embodiment of the invention described in detail hereinafter, a non-woven fibre fabric layer comprising neutral or hydrophobic fibres, eg. polyester fibres, is formed and a preselected pattern of a hydrophilic material eg. styrene-butadiene rubber is applied thereto; polyester fibres are slightly hydrophobic and the applied patterns of styrene-butadiene rubber are more hydrophilic. The pattern of rubber provides distinct ways in the non-woven fibre fabric through which liquid may permeate the fibres.

In another embodiment, a non-woven fabric which is hydrophilic has a hydrophobic modifying agent printed in a discontinuous pattern on the surface of the fabric. The pattern on the surface allows liquid to penetrate to the underlying felt but militates against expulsion of liquid from the felt through the spaces between the hydrophobic pattern even under a certain amount of pressure.

In another embodiment of the present invention an absorbent layer for incontinence or wound dressings comprises a bulk of consolidated

hydrophobic component fibres within which distinct liquid flow conduits are defined by selective hydrophilic surface treatment of segments of the bulk of consolidated hydrophobic fibres, said conduits acting to spread any liquid about the absorbent layer. In an incontinence product the conduits are arranged to move any incontinence liquid away from the vicinity of acquisition by the incontinence product and in a wound dressing product including an absorbent layer having distinct liquid flow conduits throughout its volume likewise the exudate is removed, thus ways defined by the conduits are arranged to move any exudate liquid away from the vicinity of acquisition of that liquid by the product.

In one aspect the invention may be considered to provide a method of modifying the absorbency and liquid flow characteristics of a non-woven fabric comprising:

- (i) procuring a non-woven textile fibre first sheet material;
- (ii) selecting a modifying agent which is substantially more hydrophobic or hydrophilic than the fibres of the non-woven sheet material; and
- (iii) applying the modifying agent to the non-woven sheet material in a pre-selected pattern.

In one preferred method in accordance with the invention the fibres are hydrophobic or neutral, that is neither significantly hydrophobic nor hydrophilic, and the modifying agent is hydrophilic. Suitably in this case the fibres may be polyester textile fibres and the modifying agent may comprise a suitable rubber composition, for example a styrene-butadiene rubber, and the composition may include, if desired, additional hydrophilic additives applied as a suspension, the method further comprising drying the suspension to deposit the applied rubber. However,

other neutral fibres and hydrophilic modifying agents may be used instead.

In another method in accordance with the invention, the modifying agent is a vinyl monomer solution or suspension. This method further  
5 comprises propagating within the applied pattern a graft-copolymerisation reaction between the hydrophobic components of the fibre surface and the vinyl monomer using ultra-violet radiation in order to create cross-linked polymerisation groups bonded to the fibres and thus ensure surfaces of the hydrophobic component fibres acquire a hydrophilic nature. The  
10 hydrophobic fibres may conveniently be polypropylene fibres.

Preferably in carrying out a method in accordance with the invention the non-woven textile fibre first sheet material is a needle-entangled non-woven fibre fabric.

15

In carrying out one preferred method in accordance with the invention the pattern of modifying agent is applied to one surface of the sheet material and the amount of modifying agent is chosen such that the pattern of modifying agent extends only part way through the sheet material so that  
20 the material has a layer or strata extending from one surface which is free from modifying agent and a contiguous strata which carries a pattern of the modifying agent. Suitably in a preferred method a second sheet material is secured to the first sheet material contiguous with a region of the first sheet material to which the pattern of modifying agent has been  
25 applied. In one method in accordance with the invention the second sheet material is impervious. In another method in accordance with the invention the second sheet material is a hydrophobic non-woven textile fibre fabric and thus the strata of non-woven fabric having the pattern of modifying agent may be located between two strata of non-woven fabric

without any modifying agent in the outer strata. A similar structure may be formed by producing three separate layers of non-woven fibre fabric of which only one is treated with modifying agent and assembling the treated strata between two untreated strata and securing them together for  
5 example by needle-entanglement.

Conveniently, in carrying out a method in accordance with the invention, the modifying agent is applied by printing or by using a mask of an appropriate pattern and spraying or painting the modifying agent solution  
10 or suspension through the openings in the mask onto a surface of the first sheet material. Where the material is applied by printing it may conveniently be applied by impregnating and/or coating a non-woven felt using a print roller.

15 Conveniently, in carrying out a method in accordance with the invention the modifying agent is applied as a latex or suspension and many rubbery polymeric materials may be suitable, for example acrylics, ethylene vinyl acetate copolymer, other ethylene or vinyl copolymers and polyurethanes.

20 Where several non-woven textile fibre sheet materials are secured together to form a non-woven fabric they may be secured in any convenient manner for example needle-entanglement, discontinuous adhesive or stitching.

25 In another aspect the invention may be considered to provide a sheet material suitable for use in absorbing liquid comprising a first layer of fibres having applied thereto a preselected pattern of a modifying agent which is substantially more hydrophobic or hydrophilic than the fibres, whereby to modify the performance of the fabric. Suitably the

performance is modified by providing distinct ways in the material through which liquid may permeate the layer of fibres and/or by militating against expulsion of liquid from the material, when the material is in use.

- 5 In one material in accordance with the invention the fibres are hydrophilic and the modifying agent is hydrophobic.

In another material the modifying agent is formed by graft-copolymerisation of a vinyl monomer to the surface of each treated fibre  
10 to ensure those surfaces of the fibres acquire a hydrophilic nature.

In one sheet material in accordance with the invention the pattern of modifying agent extends only part way through the sheet material so that the sheet material has a layer extending from one surface which is free  
15 from modifying agent, and a contiguous layer which carries a pattern of modifying agent.

Conveniently a material in accordance with the invention may comprise a second layer of fibres secured to the first layer and contiguous with a  
20 region of the first layer to which the pattern of modifying agent has been applied. The second layer may be an impervious sheet material secured, for example adhered, to the first layer, or may be a hydrophobic non-woven textile fibre fabric; other second layers may be used if desired.

- 25 In another aspect the invention may be considered to provide an absorbent product suitable for use in absorbing bodily fluids and which facilitates the spread of liquid about the absorbent layer, the product comprising a material in accordance with the invention.



- Preferably an absorbent product in accordance with the invention includes a material in which the pattern of modifying agent defines a first region which, in use, is intended to be positioned adjacent the source of liquid to be absorbed, to provide a region of acquisition of liquid to be dispersed.
- 5 The pattern also preferably includes a second region providing a sink in which liquid transferred through the ways from the first region may be collected.

- Conveniently a product in accordance with the invention comprises an
- 10 acquisition layer arranged to accept the bodily fluid discharged from the body and a dispersion (or "wicking") layer contiguous with the acquisition layer, adapted to disperse the acquired liquid from the acquisition layer throughout the dispersion layer.
- 15 There now follows detailed descriptions, to be read with reference to the accompanying drawings, of methods of modifying the absorbency and liquid flow characteristics of non-woven fabrics and materials suitable for use in absorbing liquid made by the methods. It will be realised that these methods and materials have been selected for description to illustrate the
- 20 invention by way of example.

In the accompanying drawings:

Figure 1 is a schematic plan view showing a first material embodying the invention;

- 25 Figure 2 is a view in cross-section of an absorbent layer suitable for use within an incontinence product or wound dressing;

Figure 3 is a schematic plan view showing a second material embodying the invention;

Figures 4 to 7 are views corresponding to Figure 3 showing the

dispersion of liquid throughout the material of Figure 3;

Figure 8 is a plan view of a sixth material embodying the invention;

Figure 8a is a view in section of part of the material shown in Figure 8;

5        Figures 9 and 10 are diagrammatic views of forth and fifth materials embodying the invention suitable for use in an incontinence pad to reduce wet-back;

Figure 11 is a diagrammatic view showing a step in the manufacture of material shown in Figures 9 and 10;

10        Figure 12 is a diagrammatic view showing various alternative methods of making a material embodying the invention;

Figure 13 is a diagrammatic view showing a method of making a third sheet material embodying the invention in which the tendency to wet-back is reduced;

15        Figure 14 is a diagrammatic view illustrating the performance of the material made in accordance with Figure 13;

Figure 15 is a diagrammatic view of a seventh illustrative sheet material including features of the second and third embodiments of the invention.

20

Referring to Figures 1 and 2 of the accompanying drawings. Essentially, a layer 1 of non-woven hydrophobic fabric is produced by conventional techniques. Thus, for example, hydrophobic fibres may be needle-entangled and consolidated to provide a non-woven felt of an appropriate  
25        density and gauge for eventual use. The gauge and density of a non-woven felt to a large extent determines the degree of entanglement and consolidation of that felt. Furthermore, the greater the degree of consolidation the less volume available to accommodate liquid in the interstices between fibres of the non-woven felt. It will be understood that

some essentially hydrophilic fibres could be provided with the non-woven fabric or felt.

Typically, non-woven felts can be made from hydrophobic and/or hydrophilic fibres or blends thereof. Hydrophobic fibres do not absorb liquid whilst hydrophilic fibres either absorb liquid by electrostatic or chemical bonding or through physical constraint, i.e. storage in the interstices between fibres. Potential problems can be created by hydrophilic fibres in that they may swell or turn to a gel upon absorption of liquid or may retain liquid within the structure, delaying drying. Such changes may inhibit convenient liquid flow within the absorbent layer and constrain liquid to the area through which it is absorbed into the absorbent layer. Furthermore, conversion to a gel, etc. is a one-way process and prevents recycleability of the fabric.

The objective of a good absorbent product for absorbing bodily fluids eg. an incontinence pad or wound dressing is that the liquid, whether it be incontinent or wound exudate is distributed widely within the absorbent layer.

Hydrophobic fibres retain their structural strength when wetted as the fibre does not become physically bonded or swell/gel with the liquid or embrace the water or saline solution. Thus, hydrophobic fibres are particularly useful within incontinence products where there may be significant compressive pressures applied to the absorbent layer 1 due to patient movements, etc. Ideally, the structural strength of hydrophobic fibres should be combined with the liquid control and absorption benefits of hydrophilic fibres in order to ensure proper distribution of absorbed liquid throughout the absorbent layer 1, thus maximising absorption capability of

a fabric.

In a first embodiment of the present invention hydrophobic fibres, namely polypropylene fibres, are needle-entangled into a non-woven felt layer 1. Upon this non-woven felt a pre-selected pattern 2 of a modifying agent is deposited by impregnation or coating. In the first embodiment the modifying agent is a vinyl monomer solution or suspension. This vinyl monomer is reacted under propagation from an ultra-violet radiation source such that the vinyl monomer is cross-linked with the surface of the polypropylene fibres. The vinyl monomer cross-linked with the surface of each polypropylene fibre provides a graft-polymerised hydrophilic surface to the (normally hydrophobic) polypropylene fibre. The hydrophilic surface of the fibres in the pattern 2 applied to the non-woven felt layer 1 provides a network of ways (or conduits) to distribute liquid about the plane of the absorbent layer 1. Furthermore, the compressive forces applied by a patient moving about may stimulate liquid flow through and along the pattern 2 of ways.

In a modified form of the first embodiment, a second layer or strata of non-woven felt could be applied to provide an acquisition layer above the first, absorbent layer 1 of non-woven felt such that the conduit network 2 is therebetween. The first and second layers or strata of non-woven felt could be secured together by needle-entanglement or some other appropriate securing technique. Thus, the pattern 2 would provide a distribution network through the absorbent layer comprising a first and second strata of non-woven fabrics. At peripheral areas of the absorbent layer expanded sink areas 3 of the conduit network 2 could be provided to act as sinks or reservoirs where liquid could be retained. Thus, pooling below a patient is limited.

A technique for rendering hydrophobic fibres such that they have a hydrophilic surface nature (as outlined above) is described in International Patent Publication No. W093/01622 (Scimat Limited). The example  
5 described relates to battery separator plate materials. In this description a non-woven felt is impregnated with a co-polymerising acrylic acid or another vinyl monomer solution or suspension such that the hydrophobic nature of the polypropylene fibres is overcome at its surface and the fibres become wettable, i.e. there is physical bonding or association by water  
10 molecules with the treated fibre surface. The wettability is achieved by a polyolefin surface to the polypropylene fibre. The polyolefin surface is provided from the co-polymerised acrylic acid or vinyl monomer and is attached by a polymerisation process. The co-polymerisation process is initiated or propagated by irradiation with ultra-violet radiation energy.  
15 The subject matter of International Patent Publication No. W093/0162 should be incorporated into the present description as an example of the process for converting hydrophobic fibres to a pseudo-hydrophilic nature at its surface.

20 In carrying out a method of modifying the absorbency and liquid flow characteristics of a non-woven fabric in making a material in accordance with the first embodiment of the invention, the impregnation techniques described in W093/01622 are used to co-polymerise acrylic acid or another vinyl monomer solution or suspension with the polypropylene  
25 fibres at separate distinct areas of the non-woven felt layer 1 in order to create liquid flow conduit path ways forming the pattern 2. By use of these ways stagnation of liquid in an absorption layer for incontinence products or wound dressings is diminished. The hydrophilic nature applied to the hydrophobic fibres ensures that preferred liquid flow pathways within the

absorbing layer are achieved ensuring good liquid distribution in the absorption layer 1. The pattern 2 acts to draw liquid along it by a combination of capillary action and flow stimulation by patient movement. Thus, the liquid is spread about the absorbent layer 1.

5

The vinyl monomer in solution or suspension is selectively impregnated in the chosen areas of a non-woven felt by any appropriate means including a rotary screen printing process. In a rotary screen coating process the vinyl monomer impregnant is applied to the non-woven fabric or felt through holes in a printing screen. Depth penetration of the vinyl monomer impregnant is controlled by varying the viscosity of the impregnant solution, i.e. vinyl monomer carrier medium, pre-wetting the non-woven felt, i.e. inhibiting impregnation or passing the non-woven felt through a nip calendar after impregnation. A mask may be used instead, the impregnant being applied by spray, print roller or other suitable technique.

10  
15

In order to propagate the graft-polymerisation reaction between the polypropylene surface and the vinyl monomer, ultra-violet lamps and thus UV radiant energy is provided to initiate the reaction and any un-reacted components after treatment are removed from the non-woven felt by a washing process. The non-woven fabric is dried after reaction to create the conduit pathways within the absorption layer.

20

Typically, after providing the conduit pathway or network within the absorption layer the non-woven felt will be cut to an appropriate size to create for example an incontinence bed pad. This non-woven fabric will have areas of hydrophobicity and hydrophobicity as determined by the impregnation process. Thus, different liquid distribution and acquisition

25

properties can be tailored to the desired performance of the incontinence product or wound dressing. For example, it may be desirable for the bulk of the liquid to be retained at and be distributed swiftly to the periphery of the layer if possible. Patient movements normally will not take place over the saturated, peripheral storage area 3 of the layer 1.

In accordance with normal practice the non-woven felt produced with the conduit pattern 2 described above ie the first illustrative sheet material, will generally have a top liquid transmission layer and a bottom liquid barrier layer with appropriate edging. The other illustrative materials likewise would typically be assembled with a top liquid transmission layer and a bottom liquid barrier layer to provide products, eg incontinence pads or wound dressings, for absorbing bodily fluids. The assembly used in wound dressings or incontinence products is commonly a sandwich of these elements appropriately secured together.

Use of the present method of modifying characteristics of a non-woven fabric is useful in an absorption layer 1 and in products such as incontinence pads or wound dressings, avoids the need to cut, place and join felts of different fibre types having different degrees of hydrophilicity and hydrophobicity in order to create liquid distribution within an absorption layer. Furthermore, the hydrophobicity of the non-woven fabric in the first embodiment of the invention ensures that the absorption layer 1 retains some structural strength with the inherent retention of interstices between hydrophobic fibres which can act as in effect stores for absorbed liquid.

The graft polymerised polyolefin surface to the polypropylene fibres is substantially permanent and retains its ability for wetting of those fibres

even after washing. Furthermore, as the wetting of the fibres may be via a physical bond at the surface of the fibres and at interstices rather than a chemical bond the non-woven absorption layer can be dried by simple centrifugal force, i.e. spin drying followed by elevation of temperature in order to evaporate liquid out of the absorption layer in normal circumstances, i.e. break the weak physical bond using relatively little heat energy. However, it may be that use of bleaching agents and other chemical reactants may create stronger physical and even chemical bonding with the coating to the polypropylene fibres and care must therefore be taken with regard to sterilisation, deodorising and sanitising of the absorption layer 1. However, typically the absorption layer should be able to withstand several washing cycles and thus is certainly more recyclable than many conventional absorption layers.

It will be understood that the necessary exposure to ultra-violet radiation is determined by the depth of impregnation into the non-woven fabric by the vinyl monomer solution or suspension. However, the ultra-violet radiation provides initiation and thus it is possible given the correct conditions for the copolymerisation reaction to be almost self-propagating after initiation.

Several patterns 2 could be superimposed one on top of the other to create better liquid distribution within the absorption layer, if desired.

Each printed pattern upon the non-woven layer 1 is surrounded by untreated hydrophobic component fibres. Thus, each segment of the pattern is encapsulated by a barrier of hydrophobic material with the result that wicking along the ways provided by the pattern is facilitated.



A range of hydrophobic fibres could be used in carrying out the first embodiment of the invention including PET and polyester along with polypropylene fibres as described.

5 At the core of the present invention in the use of print specified performance in the non-woven layer 1 to improve absorbence spread and volume. Segments or areas of the non-woven can be selected to have different grades of absorbence to maximise patient comfort. The edge of the layer 1 may be made of hydrophobic materials and thus can act as a  
10 barrier to leakage whilst central regions of the absorbent layer 1 may have the conduit pattern 2 to hold and distribute liquid.

In Fig. 2 a cross-section of an absorbent sheet material 20 is shown comprising a first strata 21 and second strata 22. The first strata 21 and  
15 the second strata 22 are non-woven materials and, for the purposes of example, the first strata 21 could be polypropylene fibres and the second strata 22 made from PET fibres. Both PET and untreated polypropylene fibres are hydrophobic. However, a central region 23 of the first strata 21 has been treated as described above with a vinyl monomer in order to  
20 render it hydrophilic, i.e. wettable. Thus, this region 23 may be wetted and act as a way (or effectively, a conduit) through which liquid can flow by a wicking or capillary action. However, the outer regions 24,25 of the first strata 21 are untreated polypropylene fibres and the second, base, strata 22 are both hydrophobic and thus act as leakage barriers.

25 In use of the first illustrative sheet material, a further non-woven fabric layer or a coating layer may be added to the top surface of strata 21. This further layer will allow liquid to pass through it whilst facilitating good low or high adhesion properties alone with possible liquid spread function

as required. Similar layers may be added to the other illustrative sheet materials also.

A second material embodying of the invention is now described with  
5 reference to Figures 3 to 7 of the accompanying drawings. In carrying out  
a method of modifying the absorbency and liquid flow characteristics in a  
non-woven fabric to make the second illustrative material, a non-woven  
textile fibre first sheet material of neutral or slightly hydrophobic fibres is  
obtained. Suitable sheet material comprises polyester 6.7 decitex fibres  
10 made by well known non-woven textile fibre fabric manufacturing  
techniques, including needle-entanglement, and is produced at a weight of  
about 380 grams per square meter. A relatively hydrophilic rubber latex  
is selected as a modifying agent for the polyester sheet material and  
applied to the surface of the non-woven sheet material 30 in a preselected  
15 pattern 32. In Figure 3 the pattern 32 is shown bounded by dashed lines  
and encompasses a roughly circular central region 34 which is untreated  
and which is surrounded by a further untreated region 36.

The modifying agent may be applied to the sheet material by any  
20 convenient technique, for example printing utilising a suitable screen  
printing apparatus or by painting the pattern onto a surface of the sheet  
material using a stencil and applying the material either by brush or spray.

The applied rubber latex is pressed to completely saturate the area treated  
25 with the modifying agent and the liquid is evaporated from the latex in a  
suitable drying apparatus thus depositing the rubber which will adhere to  
some extent to the fibres typically resulting in a local binder to fibre ratio  
by weight of between 0.1:1 and 0.5:1.

Figures 4 to 7 of the accompanying drawings show the performance of the second illustrative material. A small amount of tap water coloured using a few drops of red ink was poured onto the untreated region 34 of the sheet material 30. The water tended to puddle on the surface until it made  
5 contact with the pattern 32 of the treated region. When this happened the liquid was quickly soaked into the treated area (see Figure 5) removing the puddle from the surface of the fabric and leaving the untreated central area 34 dry. Over a short period the liquid was seen to permeate within the treated area along ways in the non-woven fabric formed by the nitrile  
10 rubber treatment of the fibres, as shown in Figure 6. Finally, the liquid reached the edge of the treated area, as shown in Figure 7, being fully dispersed about the area formed by the pattern 32 until it reached the outer edges of the pattern 32 as defined by the dashed lines remote from the central area 34. On reaching the outer edges, the liquid accumulated in  
15 the untreated region 36 surrounding the pattern 32.

It was noted that the region 30 of the pattern 32, treated with a rubber, is extremely resilient to compression and there is little or non tendency for the liquid to ooze out to wet-back the surface of the non-woven material  
20 30 when the material is pressed. Furthermore the central region 34 was substantially dry.

Thus, should an incontinence product or wound dressing be produced using a material as shown in Figures 3 to 7, the central region 34 should  
25 be placed adjacent the source of liquid which is then conducted away from the vicinity of acquisition of the liquid and dispersed throughout the material leaving the region 34 substantially dry. The region 36 at the periphery of the material is hydrophobic and militates against leakage of liquid from the edge of the material.

Should such a material be incorporated in a washable product, such as an incontinence product, the material may be washed and spun dry, removal of the liquid being relatively simple.

5

In incontinence products it is especially important that a tendency to "wet-back" is minimised ("wet-back" is the tendency of liquid which has been absorbed into an absorbent material to be forced from the material when the material is subjected to pressure). Wet-back is a possibility especially in incontinence products for bedridden patients because of the weight of the body applied to the incontinence product applies pressure which may lead to wet-back: wet-back is undesirable because of the tendency of wet skin to form bed sores.

10

15 In a third embodiment of the invention described with reference to Figures 13 and 14, and similar in some respects to the second embodiment, a polyester needle felt sheet material is used but of a heavier weight and the modifying agent is a styrene-butadiene rubber latex. In the third embodiment, a non-woven textile fibre sheet material of 6.7 decitex  
20 polyester is made by well known techniques and is made at a rate of 500 grams per square metre. A modifying agent comprising a styrene-butadiene rubber latex eg. Synthomer 7050, at a viscosity of about 30,000 cps is used. The modifying agent is applied to the non-woven textile fibre sheet material in the form of a dispersion comprising, in parts by weight,

25

<u>Component</u>	<u>Parts by Weight</u>
styrene-butadiene rubber latex 7050	300
Nuwet (hydrophilic additive/wetting agent)	30

water	3000
ammonia (pH modifier)	3
Viscalex 8330 (pH dependent thickener)	50

5 this dispersion is approximately 4.5% by weight solids.

Approximately 500 grams per square metre of the dispersion was applied with a blade to the back of the non-woven textile fibre sheet material 40 (see Figure 13) as a coating 42; while still wet the coated sheet material  
10 was passed between a pair of calendar rolls 44 with a 2 mm gap therebetween to force the coating 42 into the sheet material 40. With the conditions specified, the non-woven textile fibre sheet material is modified by forcing the modifying agent through about half the thickness of the sheet material 40 to form the third illustrative sheet material 46 suitable  
15 for as an absorbent material.

The third illustrative material 46 is shown in Figure 14 and has an open acquisition layer 48 with a resilient slightly less open layer 50 (the part of the non-woven fibre sheet material into which the dispersion coating 42  
20 has been forced). The layer 50 is hydrophilic and tends to draw the fluid out of the acquisition layer and the fluid permeates horizontally away from the source 52 of fluid as indicated by the arrows in Figure 14. As with the second material impregnated with nitrile rubber, the styrene-butadiene rubber is resilient in nature, as it bonds to some extent to the fibres, and  
25 tends to resist compression of the material 46 under load; this further acts to prevent the stored liquid wetting-back to the surface of the material 46. The styrene-butadiene rubber can be applied to the non-woven textile fibre sheet material 40 in any desired pattern according to the use to which the end product 46 is to be put; eg. a pattern similar to that described with

reference to the second embodiment and shown in Figures 3-7 of the accompanying drawings may be used.

5 In the illustrative embodiments discussed above, the patterns involved have been generally horizontal extending, in the same plane as the sheet material.

10 In fourth and fifth sheet materials embodying the invention, a relatively high gauge needle felt with a gauge of 3 mm or above is used and the position of the modifying agent is controlled both in the plane of the sheet material and through the thickness of the textile fibre fabric sheet material using a relatively viscous modifying agent. In the fourth and fifth  
15 embodiments such a viscous agent is applied in a pre-selected lateral pattern combined with relatively precise application of pressure to the agent to spread the agent in a controlled way through the depth of the fabric. The fourth and fifth embodiments of the invention are described hereinafter with reference to Figures 9, 10 and 11 of the accompanying drawings, in principle; they have certain aspects in common.

20 In Figure 9 a non-woven textile fibre fabric sheet material 54 is shown; in the fabric 54 the fibres are neutral or hydrophilic. A pattern of relatively hydrophobic modifying agent is applied to form cones extending part way through the thickness of the fabric 54 as shown in Figure 9.

25 In the manufacture of the forth illustrative material shown in Figure 9 the cones 56 need to be applied from the base of the cone and thus the material 54 must be made in two parts, an acquisition layer 58 and a dispersal layer 60, the dispersal layer 60 being applied to the surface of the acquisition layer 58 at which the wide end of the cone appears,

pressure being applied to spread the modifying agent within the fabric to reduce the cone shape which tapers away from the base shown in Figure 9.

5 In the manufacture of the fifth illustrative sheet material shown in Figure 10, which comprises hydrophobic or neutral base fibres and a more hydrophilic modifying agent, the cones 66 in the acquisition layer 64 are formed in a similar way to those shown in Figure 9, namely application of a modifying agent to the surface of the acquisition layer 64 and a  
10 dispersion layer 68 also being included. The material 62 may be made in two separate parts with the layers 64, 68 being subsequently secured together or, preferably, made from a single non-woven textile fibre sheet material by applying the modifying agent to produce the dispersion layer 68 in the manner described with reference to the third embodiment of the  
15 invention, shown in Figure 12 and by applying the modifying agent to form the cones 10 from the opposite face of the fabric 62 by placing spaced deposits of modifying agent on that surface of the fabric and subjecting the deposits to pressure to force the modifying agent into the fabric. Suitably the modifying agent used in production of the materials  
20 described with reference to Figure 10 is a styrene-butadiene rubber suspension as described above with reference to the third embodiment and the textile fibres used are similar polyester textile fibres.

In the case of the materials shown in Figures 9 and 10, liquid contacting  
25 the acquisition layer 58, 62 is absorbed into the dispersion layer 60, 68 and permeates throughout the dispersion layer 60, 68 as indicated by the arrows A. Wet-back, as indicated by the arrows B, is inhibited by the hydrophobic cones 56 in the material shown in Figure 9 and by similar regions 70 of the hydrophobic or neutral acquisition layer with regard to

the material shown in Figure 10.

In Figure 11 a technique for producing the conical regions of modifying agent used in materials described with reference to Figures 9 and 10 is shown and described with reference to the material of Figure 9. In Figure 11 the acquisition layer 58 has deposited on it a deposit 72 of hydrophobic material. This is then subjected to pressure P and, as a result, conical deposits 56 of the modifying agent are formed.

By using different shapes of tool the deposit 72 of modifying agent can be caused to adopt different configurations within the acquisition layer 58, 64. In Figure 12 various tools 74 are shown acting upon deposits of modifying agent positioned on the surface of an acquisition layer 58, a deposit 76 which has not been subjected to any pressure is shown in Figure 12 for comparison and the shape of the deposits 78 produced by the various tools 74 are indicated in Figure 12. Although in Figure 12 single tools are indicated, it would of course be feasible to include a single presser member carrying a plurality of tools 74. Preferably the tools 74 will all be of a similar configuration but, if desired, tools of various configurations could be utilised to provide various desired effects in the pattern of a modifying agent applied to the non-woven fabric.

In use of the tools shown in Figure 12 the depth of penetration of the deposit of modifying agent is controlled by the pressure applied by the tool as well as the shape of the tool. If sufficient pressure is applied the modifying agent will be distributed to form a parallel sided block within the textile fabric and more lateral spreading will occur.

In a sixth embodiment of the invention, a method of modifying the



absorbency and liquid flow characteristics of a non-woven fabric comprising a non-woven textile fibre first sheet material of hydrophilic fibres is used and described with reference to figures 8 and 8a.

- 5 A hydrophilic base felt 39 is made by well known techniques for making non-woven fabrics.

In this sixth embodiment a powdered hot-melt polymer of hydrophobic material, for example ethylene vinyl acetate copolymer, is used as the  
10 modifying agent. The polymer powder is sprinkled onto the surface of the fabric 39 to create a branched pattern 41 (see Figure 8). The powder 43 is sintered using heat and creates discontinuous rounded deposits 43. The deposits 43 projected above the surface of the textile fabric (see Figure 8a). In testing the illustrative sheet material, liquid is applied to a central  
15 region 45 of the pattern and is observed to permeate throughout the non-woven textile fibre sheet material rapidly; by comparison with a similar test material without the pattern 41, the general liquid penetration and spread appears not to be affected by the pattern.

- 20 However, the pattern 41 is found to reduce wet-back when the surface of the sheet material carrying the pattern 41 is pressed by hand, the sixth material in accordance with the invention feeling substantially dry whilst the test material without the pattern of modifying agent, feeling wet.

- 25 It is believed that the pattern of modifying agent creates a physical obstruction to liquid wet-back from within the textile fibre fabric when subject to pressure, but provides no obstruction to absorption of the liquid by the fabric because the liquid is directed by the hydrophobic pattern to the regions between elements of the pattern which is readily absorbed.

In a suitable surface treatment with hydrophobic modifying agent applied in a desired pattern, the modifying agent can be applied as a sintered hot-melt powder as described above or in other ways, for example, as a  
5 printed-on discontinuous coating for example, by powder dot or paste dot printing processors.

A surface treatment providing a surface pattern of hydrophobic modifying agent as described in the sixth embodiment of the invention can be  
10 combined with the methods described with reference to the second or third embodiment of the invention provided that the surface pattern is at least as hydrophobic as the non-woven fibres utilised and preferably of greater hydrophobicity. Further, the method of the fourth embodiment may also be combined. A seventh material embodying the invention, including the  
15 features of the second or third and sixth embodiments of the invention is shown in Figure 15.

In Figure 15 is shown a sheet material having a discontinuous raised dot surface on a material otherwise similar to that shown in Figure 14. The  
20 structure shown in Figure 15 allows the liquid to flow past the raised dots 80 which are provided using a hydrophobic latex printed on the surface of the sheet material shown in Figure 14. The liquid applied to the surface is able to flow past the dots 80 into an acquisition layer 48 and permeate throughout the material in a dispersion layer 50 as described earlier.

25 When the seventh material is used in an incontinence pad the resilient nature of the latex dots 80 and the fact that they are raised, helps to keep a patient's body separated from liquid contained in the material 46, thus reducing wet-back; clearly the size and spacing of the dots 80 is of some

relevance. Dots 80 which are too small and too close together can increase resistance to wetting of the acquisition layer 48 unacceptably. A minimum dot separation of 1.0 mm and a maximum dot separation of 2 mm (to minimise wet-back) is preferred. A dot diameter of between 2 and 5 4 mm is believed to be suitable.

The illustrative materials are useful in products eg incontinence pads and wound dressings, for absorbing bodily fluids and dispersing them throughout the product so that the possibility of wet-back or leakage is 10 minimised.

## CLAIMS

1. A method of modifying the absorbency and liquid flow characteristics of a non-woven fabric comprising:
  - 5 (i) procuring a non-woven textile fibre first sheet material;
  - (ii) selecting a modifying agent which is substantially more hydrophobic or hydrophilic than the fibres of the non-woven sheet material; and
  - 10 (iii) applying the modifying agent to the non-woven sheet material in a pre-selected pattern.
2. A method according to Claim 1 wherein the fibres are hydrophobic or neutral, and the modifying agent is hydrophilic.
- 15 3. A method according to either one of Claims 1 and 2 wherein the fibres are polyester and the modifying agent comprises nitrile or styrene-butadiene rubber applied in as a latex, the method further comprising drying the suspension to deposit the applied rubber.
- 20 4. A method according to Claims 2 wherein the modifying agent is a vinyl monomer solution or suspension, the method further comprising propagating within the applied pattern a graft-copolymerisation reaction between the hydrophobic component fibre surface and the vinyl monomer using ultra-violet radiation in order to create cross-linked polyolefin  
25 groups bonded to the fibres and thus ensure those surfaces of the hydrophobic component fibre acquire a hydrophilic nature.
5. A method according to any one of the preceding claims wherein the pattern of modifying agent is applied to one surface of the sheet material

and the amount of modifying agent applied is chosen such that the pattern of modifying agent extends only part way through the sheet material so that the sheet material has a layer extending from one surface which is free from modifying agent and a contiguous layer which carries a pattern of modifying agent.

6. A method according to any one of the preceding claims comprising securing a second sheet material to the first sheet material contiguous with a region of the first sheet material to which the pattern of modifying agent has been applied.

7. A method according to Claim 6 wherein the second sheet material is impervious.

8. A method according to Claim 6 wherein the second sheet material is a hydrophobic non-woven textile fibre fabric.

9. A method according to Claim 6 wherein the second sheet material is a hydrophilic non-woven textile fibre.

10. A method according to either one of Claims 7 and 8 comprising a third sheet material contiguous with and interposed between the first and second sheet materials, the third sheet material being hydrophilic.

11. A method according to any one of the preceding claims wherein the pattern of modifying agent is applied in the form of deposits of modifying agent and the deposits of modifying agent are thereafter subjected to pressure to force the modifying agent into the non-woven sheet material.

12. A method according to any one of the preceding claims wherein a pattern of modifying agent is deposited on the surface of the non-woven sheet material and cured to provide a pattern of discrete raised dots on the surface of the sheet material.

5

13. A method according to any one of the preceding claims wherein the modifying agent is applied by printing, or by using a mask of an appropriate pattern and spraying or painting the modifying agent in solution or suspension.

10

14. A sheet material suitable for use in absorbing liquid comprising a first layer of fibres having applied thereto a pattern of a modifying agent which is substantially more hydrophobic or hydrophilic than the fibres, whereby to modify the performance of the fibre layer.

15

15. A sheet material according to Claim 14 where the performance is modified by providing distinct ways in the material through which liquid may permeate the layer of fibres and/or by militating against expulsion of liquid from the material in use.

20

16. A sheet material according to either one of Claims 14 and 15 wherein the fibres are neutral or hydrophilic and the modifying agent is hydrophobic.

25 17. A sheet material according to either one of Claims 14 and 15 wherein the fibres are neutral or hydrophobic and the modifying agent is hydrophilic.

18. A sheet material according to Claim 17 wherein the fibres are

polyester and the modifying agent comprises nitrile or styrene-butadiene rubber.

19. A sheet material according to Claim 17 wherein the modifying agent is formed by graft-copolymerisation of a vinyl monomer to the fibre surface to create cross-linked polyolefin groups bonded to the fibres to ensure those surfaces of the fibres acquire a hydrophilic nature.
20. A sheet material according to any one of Claims 14 to 19 wherein the pattern of modifying agent extends only part way through the sheet material so that the sheet material has a layer extending from one surface which is free from modifying agent and a contiguous layer which carries a pattern of modifying agent.
21. A material according to any one of Claims 14 to 20 comprising a second layer secured to the first layer and contiguous with a region of the first layer to which the pattern of modifying agent has been applied.
22. A material according to Claim 21 wherein the second layer is impervious.
23. A material according to Claim 21 wherein the second layer is a hydrophobic non-woven textile fibre fabric.
24. A material according to Claim 21 wherein the second layer is a hydrophilic non-woven textile fibre fabric.
25. A material according to either one of Claims 22 and 23 comprising a third layer interposed between and contiguous with the first and second

layers, the third layer being a hydrophilic layer of non-woven sheet material.

26. A sheet material according to any one of Claims 14 to 25 made by  
5 a method according to any one of Claims 1 to 13.

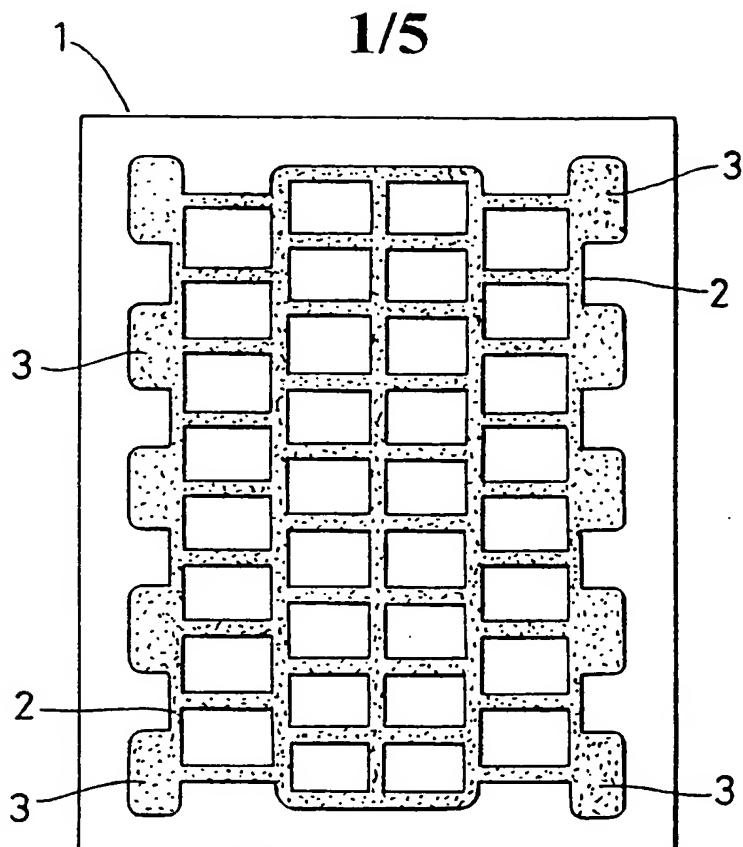
27. An absorbent layer for use within an incontinence product or  
wound dressing which facilitates the spread of liquid about the absorbent  
layer comprising a sheet material according to any one of Claims 14 to 26.

10

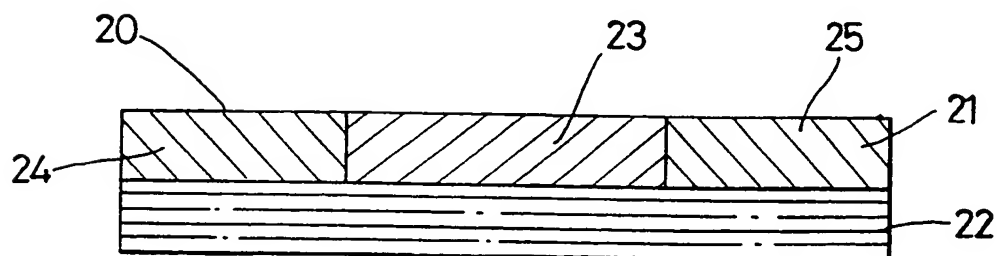
28. An absorbent layer according to Claim 27 wherein the pattern of  
modifying agent provides ways through which liquid may permeate the  
layer, the pattern having a first region which, in use, is intended to be  
positioned adjacent the source of liquid to be absorbed and a second region  
15 providing a sink in which liquid transferred through the ways may be  
collected.

20



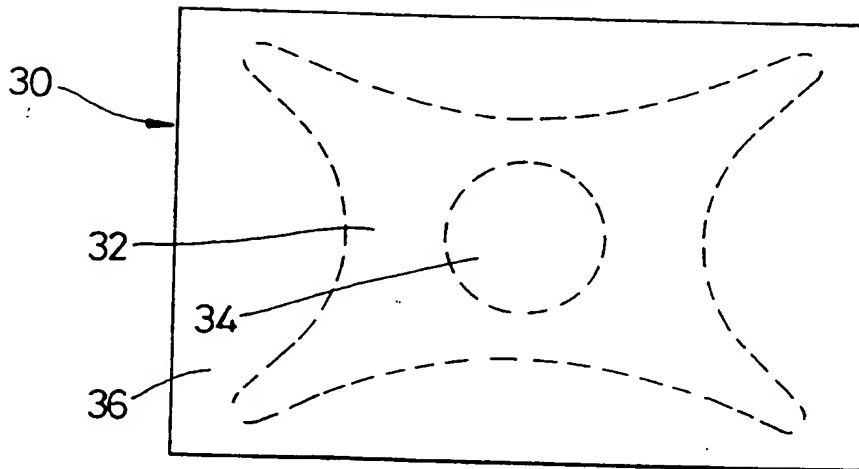
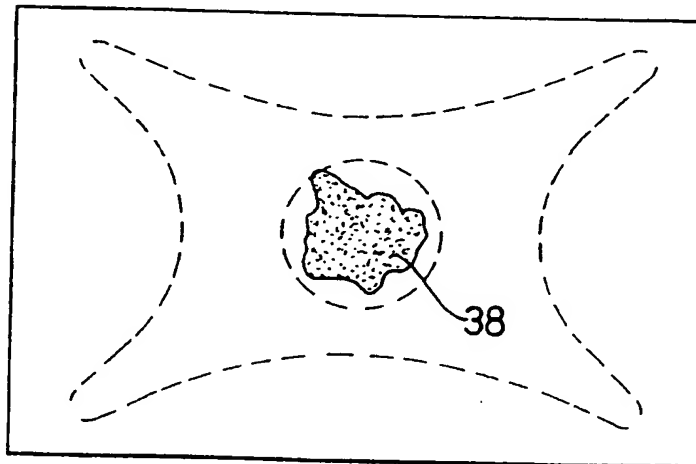
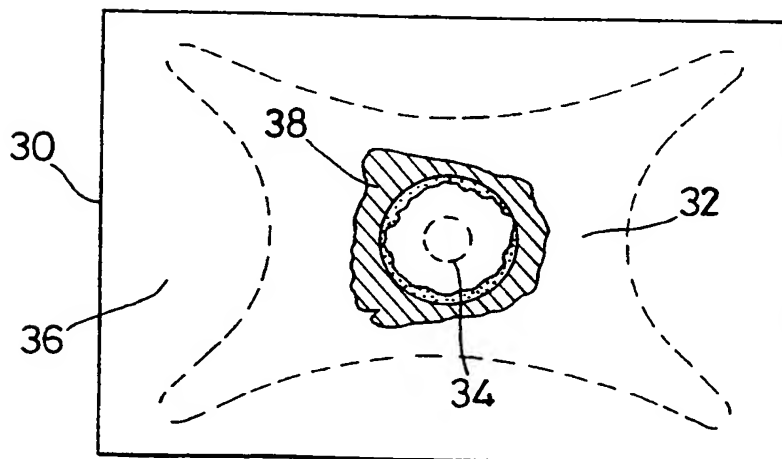


*Fig. 1*

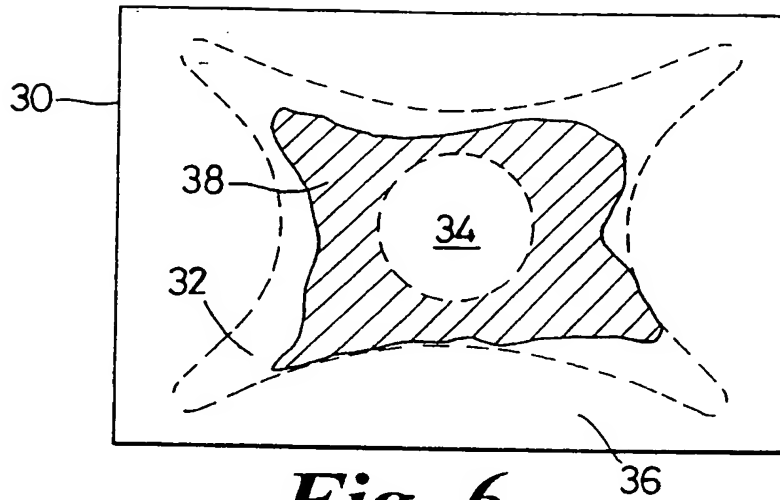


*Fig. 2*

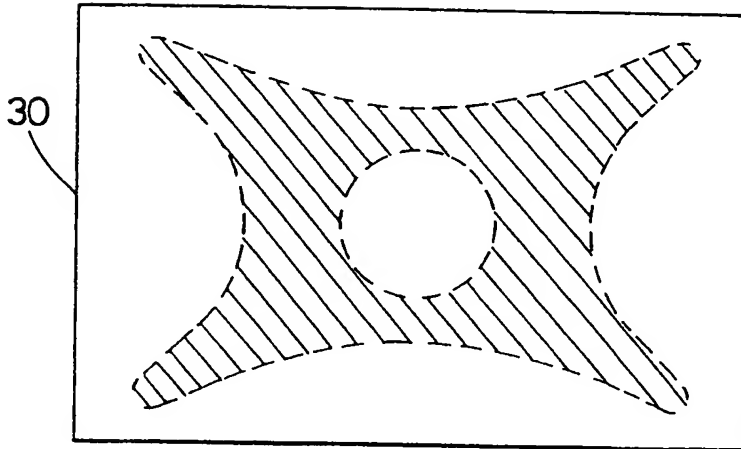
2/5

*Fig. 3**Fig. 4**Fig. 5*

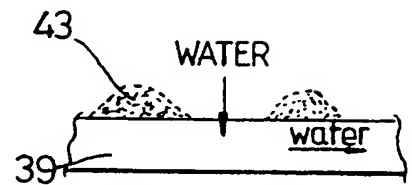
3/5



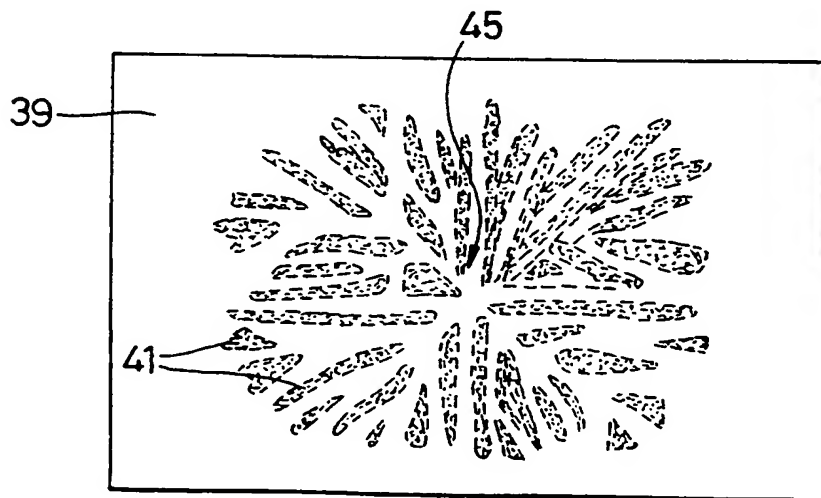
**Fig. 6**



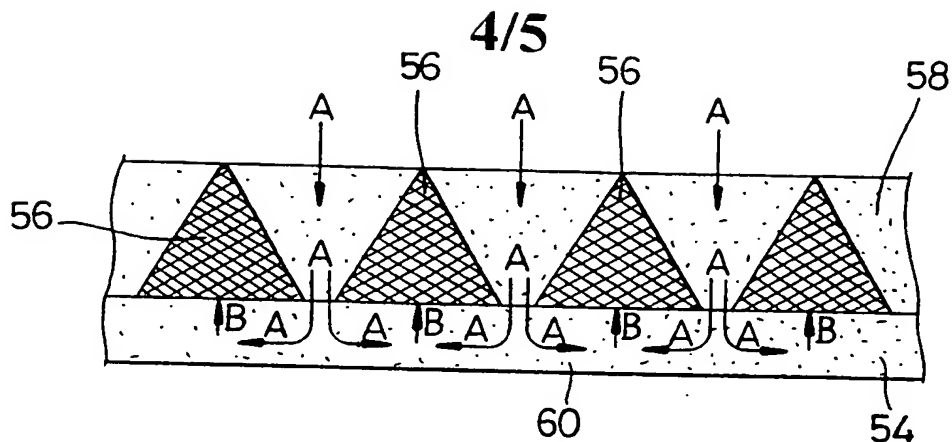
**Fig. 7**



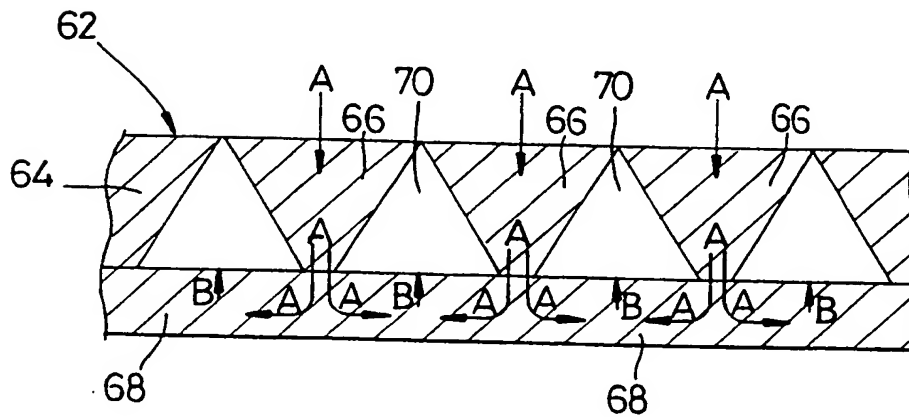
**Fig. 8a**



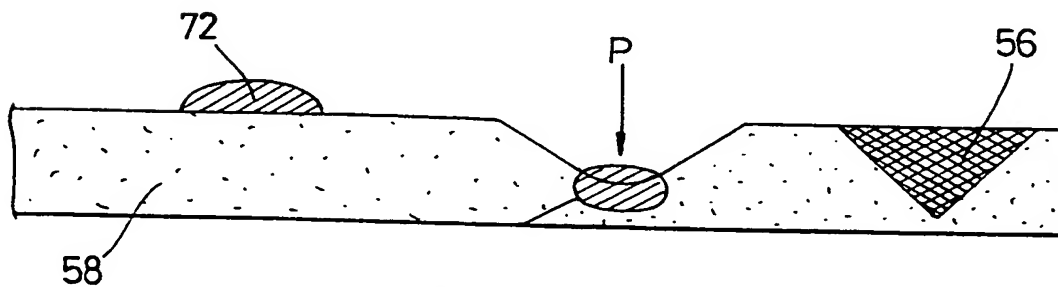
**Fig. 8**



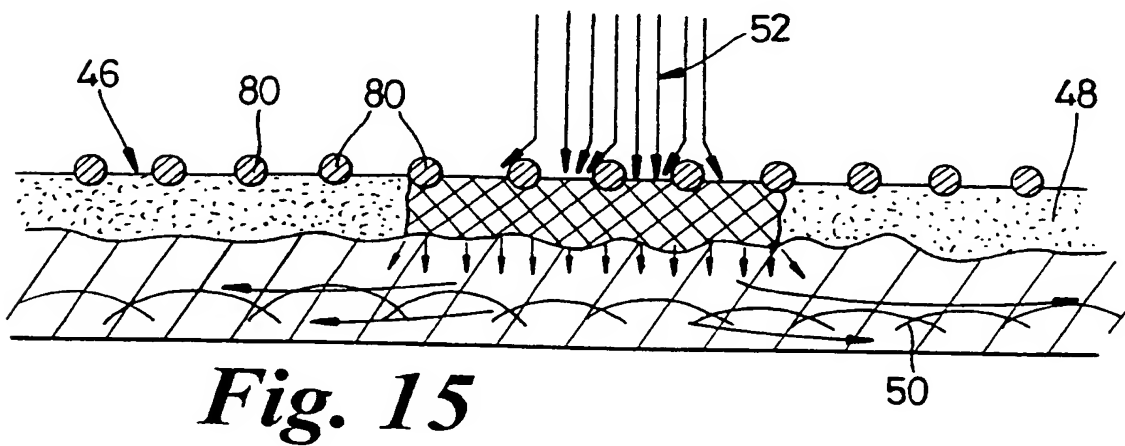
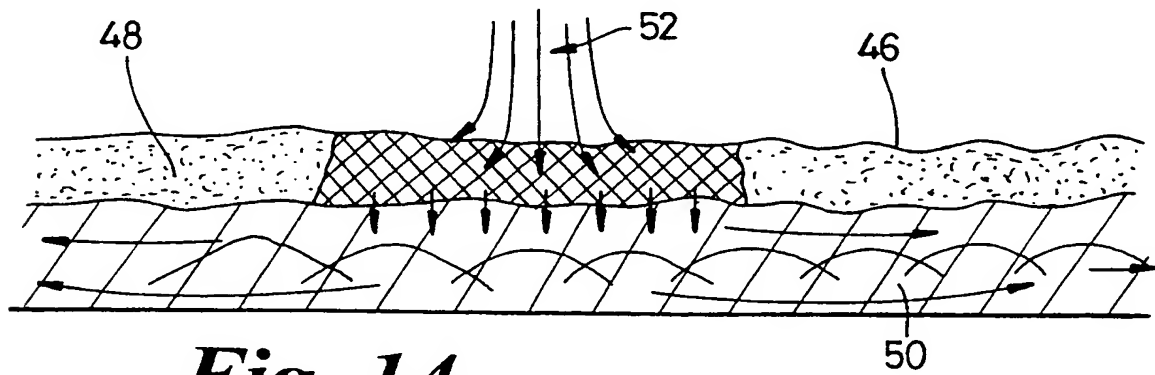
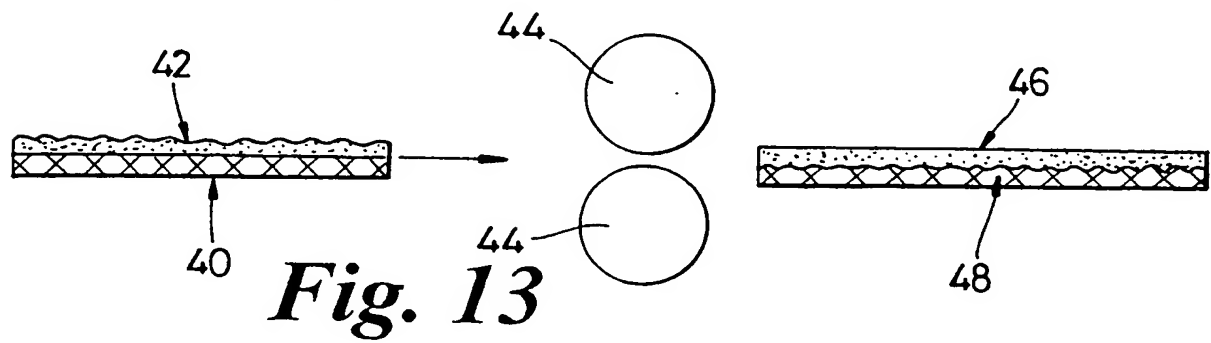
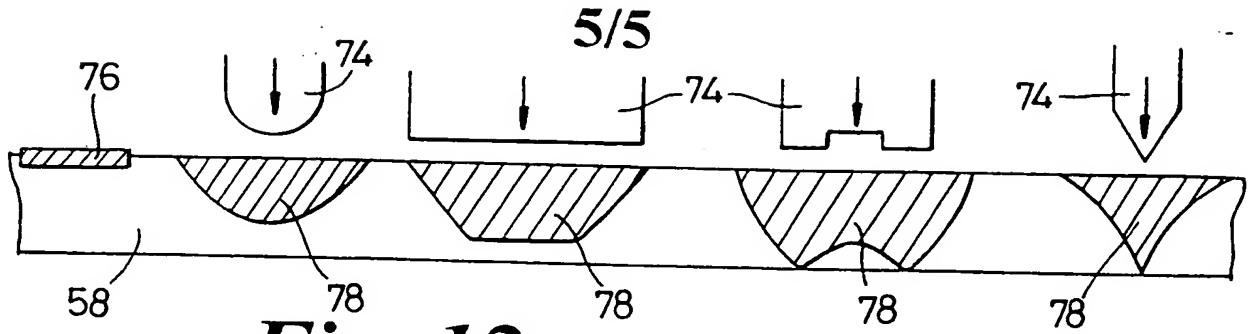
**Fig. 9**



**Fig. 10**



**Fig. 11**



# INTERNATIONAL SEARCH REPORT

In: International Application No

PCT/GB 98/01703

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A61F13/15 D06M15/693 D04H13/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61F D06M B32B D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 00656 A (PROCTER & GAMBLE) 9 January 1997 see the whole document ---	1, 14-16, 27
X	WO 95 11649 A (KROYER K K K) 4 May 1995  see the whole document ---	1, 2, 5, 6, 9, 10, 14-17, 21, 24-28
A	DATABASE WPI Section Ch, Week 8731 Derwent Publications Ltd., London, GB; Class A96, AN 87-217090 XP002079338 & JP 62 142556 A (KAO CORP), 25 June 1987 see abstract ---  -/--	1-28

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

1 October 1998

Date of mailing of the international search report

15/10/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Barathe, R

# INTERNATIONAL SEARCH REPORT

In International Application No

PCT/GB 98/01703

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, A	PATENT ABSTRACTS OF JAPAN vol. 098, no. 006, 30 April 1998 & JP 10 028700 A (OJI PAPER CO LTD), 3 February 1998 see abstract ---	1-28
A	DATABASE WPI Section Ch, Week 8527 Derwent Publications Ltd., London, GB; Class A87, AN 85-163153 XP002079339 & JP 60 094682 A (UNITIKA LTD) , 27 May 1985 see abstract ---	1-28
A	US 3 838 692 A (LEVESQUE Y) 1 October 1974 see the whole document ---	1-28
A	US 3 955 577 A (NOEL JOHN R ET AL) 11 May 1976 see column 6, line 58 - column 8, line 16 ---	1-28
A	DE 39 17 791 A (COROVIN GMBH) 6 December 1990 see figure 1 -----	1-28

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/01703

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9700656 A	09-01-1997	AU 6049296 A CA 2225160 A EP 0833598 A	22-01-1997 09-01-1997 08-04-1998
WO 9511649 A	04-05-1995	AU 7990694 A CA 2175237 A EP 0725614 A US 5622584 A	22-05-1995 04-05-1995 14-08-1996 22-04-1997
US 3838692 A	01-10-1974	NONE	
US 3955577 A	11-05-1976	US 3901238 A AT 346685 B AT 201075 A AU 7871975 A BE 826752 A BR 7501581 A CA 1034353 A CH 594374 A DE 2511141 A DK 109975 A FR 2272833 A GB 1494525 A IE 40833 B JP 50158451 A LU 72073 A NL 7503124 A SE 412686 B SE 7502985 A	26-08-1975 27-11-1978 15-03-1978 09-09-1976 17-09-1975 16-12-1975 11-07-1978 13-01-1978 09-10-1975 19-09-1975 26-12-1975 07-12-1977 29-08-1979 22-12-1975 04-02-1976 22-09-1975 17-03-1980 19-09-1975
DE 3917791 A	06-12-1990	WO 9014813 A	13-12-1990